PATENT SPECIFICATION (11) 1 449 541

1 449 541

(21) Application No. 38/74 (22) Filed 2 Jan. 1974 (19)

(44) Complete Specification published 15 Sept. 1976

(51) INT. CL.² B23K 37/04

(52) Index at acceptance
B3R 31 32A 32B 37A1X

(72) Inventors JOSEF SVERCL and JAN NOVAK

(54) IMPROVEMENTS RELATING TO THE MANUFACTURE OF TUBULAR ARTICLES

(71) We, SIGMA LUTIN Narodni Podnik, of Lutin, Czechoslovakia, a corporation organised and existing under the laws of the Czechoslovak Socialist Republic, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the manufacture of tubular articles, and more particularly to a jig for holding a substantially cylindrical tubular workpiece for an operation to be performed on a longitudinally-extending portion of the workpiece, especially, though not exclusively, for the purpose of welding a longitudinal seam on a said workpiece. The invention also relates to a welding machine having a said jig; to a method of welding a longitudinal seam on a said workpiece; and to a tubular article defined by a said workpiece on which a said manufacturing operation, e.g. the production of a welding seam, has been performed.

In one method previously proposed for the manufacture of tubular articles in the form of thin-walled cylinders used in conjunction with electric motors for submersible pumps, a tubular semi-finished product or workpiece is welded, a thin metal sheet having previously been rolled into a tubular shape for the purpose.

Such a manufacturing method requires very accurate positioning of the said tubular semi-finished product on a supporting mandrel held in a chuck, in order to ensure that the edges of the said product which are to be welded together are in contact with each other along their entire length and positioned accurately in relation to the welding torch. In this method the tubular semi-finished product to be welded is slipped over a cylindrical mandrel and clamped by means of pads or strips which also secure the mutually contiguous leading portions of the edges to be welded together. The jigs or chuck devices used in this method have a number of disadvantages: for example they entail laborious positioning of the tubular semi-finished product with respect to the welding torch, which has to be done by trial and error and entails repeated repositioning: they also make it impossible to provide satisfactory contact between the edges to be welded over the entire length of the product and controlling the pads or strips is also a laborious operation.

It is an object of the present invention to reduce or eliminate these disadvantages by providing relatively simple, easy and accurate positioning of the tubular semi-finshed product even with batch production with a higher degree of reliability in the manufacturing process.

According to the invention, in a first aspect thereof, a jig for holding a substantially cylindrical tubular workpiece for an operation to be performed on a longitudinally-extending portion of the workpiece, comprises: a mandrel having a body for supporting the workpiece internally of the workpiece and defining a mandrel axis, the mandrel body having locating means for locating said workpiece in predetermined angular relationship on the body about said axis, and the mandrel having retaining means whereby the mandrel may be held at one end thereof; a first and a second jaw, said jaws being mutually opposed and adapted to co-operate with each other to encircle a major portion of the circumference of the workpiece when the latter is on the mandrel, jaw actuating means for moving the jaws towards each other, and means for allowing the jaws to tilt relative to the mandrel about respective jaw axes parallel to the mandrel axis.

Preferably the mandrel is arranged for axial movement with respect to the jaws.

The mandrel preferably has a first and a second pin extending substantially radially outwards form the mandrel body, the said pins being spaced apart longitudinally of the mandrel, the one of said pins nearest to a free end of the mandrel being retractable into the mandrel body against biassing means in the mandrel, whereby to permit a said workpiece to be introduced on to the

mandrel past the free end thereof and then to locate the workpiece longitudinally between the said pins.

According to a preferred feature of the invention, the jaw-actuating means comprises a pair of jaw-carrying members movable in opposed relationship in a common plane transverse of the mandrel axis and on opposite sides of the mandrel axis, each jaw-carrying member having a said jaw pivoted with respect thereto to enable the jaw to be tilted in the said transverse plane about a said jaw axis.

An inner face of each jaw preferably carries a pad resiliently biassed so as normally to project therefrom towards the mandrel axis but to be retractable into the jaw, the said pads extending generally longitudinally of the respective jaws in opposed relationship to each other, and being so positioned as to engage opposite sides of a said workpiece on the mandrel in spaced angular relationship with the said longitudinally-extending portion of the workpiece.

According to the invention, in a second aspect thereof, a welding machine for welding a longitudinal seam of a tubular workpiece has a jig according to the said first aspect of the invention.

According to the invention, in a third aspect thereof, a method of welding a longitudinal seam on a longitudinally-extending portion of a substantially cylindrical tubular workpiece comprises slipping the said workpiece, having two opposed seam edges in the said portion thereof, on to the mandrel of a jig according to the said first aspect of the invention with the workpiece in predetermined angular relationship with the mandrel; engaging the jaws of the jig with the workpiece; moving the jaws towards each other whilst allowing tilting of the jaws to bring the seam edges together and to hold the seam edges against the mandrel; and whilst the seam edges are so held, operating a welding head with relative movement between the said head and edges parallel to the mandrel axis, whereby to weld the edges together.

The invention also includes within its scope an article defined by a substantially cylindrical tubular workpiece on which a manufacturing operation has been performed whilst held on a jig according to the said first aspect of the invention, and more especially to a said article having a welding seam produce in a welding machine according to the said second, or by a method according to the said third, aspect of the invention.

To illustrate the invention in its various aspects, one form of jig and a workpiece to be welded with the aid of the jig will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:—

Figure 1 shows parts of the jig in longitudinal section taken on the line I—I in Figure 2;

Figure 2 shows parts of the jig in cross-section, taken on the line II—II in Figure 1, except for the portion of Figure 2 between the two lines II*A* and the portion between the two lines II*B*, these portions being scrap sections in respective planes indicated in Figure 1 at II*A*—II*A* and II*B*—II*B* respectively; and

Figure 3 is a perspective view of the workpiece.

Referring to Figures 1 and 2, a chuck assembly 30 is mounted firmly on an arc welding machine. Of the latter, the only parts shown are a portion of the machine frame 54 (Figure 1) and a welding head indicated at 57 in Figure 2 (not shown in Figure 1). The frame 54 has a tubular stop member 65 secured thereto by a member 56, and a mandrel holder 55 of a mandrel 10 is movable axially in the members 65, 56.

The chuck assembly 30 has a base plate 60 carrying a pair of holders 31, 32 in which are mounted, for collinear axial movement in opposed relationship in the common axial plane II—II (Figure 1) jaw-carrying members in the form of respective plungers 53. The head of each plunger 53 has a pair of blocks 50 extending from it, and each pair of blocks 50 carries a spindle 51 in which a jaw plate 58, 59 respectively is freely pivoted so as to be tiltable with respect to the plungers 53. The edges of the jaw plates 58 and 59 facing each other are curved and are fixed in respective grooves 20*A*, 21*A* formed in the back of a pair of opposed jaws 20, 21 each having an arcuate inner face 61, such that the jaws are adapted to co-operate with each other to encircle a major portion of the circumference of a workpiece 40.

Each jaw plate 58, 59 has holes 20*B*, 21*B* respectively, accommodating compression springs 23, 22 which bear against the respective heads of the plungers 53. The jaws 20, 21 have respective strip-like pads 27, 26, respectively accommodated in grooves 25, 24 in the inner face of each jaw and resiliently biassed radially inwardly by springs 28.

The jig consists of the chuck assembly and the parts carried thereby and just described and the mandrel 10, for supporting a workpiece internally and having a mandrel body 10*A* defining an axis 62 parallel to that of the spindles 51 and transverse to the plane II—II. One end of the mandrel body has a portion 11 whereby it is mounted coaxially with, and so as to extend from, the mandrel holder 55. A locating pin 12

locates the mandrel body in predetermined angular relationship about its axis with respect to the mandrel holder 55, which in turn is held in predetermined angular relationship with respect to the jaws 20, 21, between which the mandrel body extends, by a key 56*A* of the member 56, slidably engaging in a keyway 55*A* of the mandrel holder.

The lower portion of the mandrel body 10*A* is provided with two centring pins 13, 14 serving to locate a substantially cylindrical tubular workpiece 40, Figures 1 to 3. The pin 14, which extends substantially radially outwardly from the body 10*A* in the vicinity of the free end of the mandrel, is retractable into the mandrel body 10*A* against a spring. The pins 13, 14 are disposed in the same axial plane of the body portion 10*A*.

The upper portion of the mandrel body 10*A*, i.e. the portion opposite the pins 13, 14, is provided with an electrically conductive, viz. copper, bearing plate 15 on a surface portion thereof, the plate 15 being fixed to the body 10*a* and located exactly below the welding head 57 so as to serve as an electrode for co-operation with the latter.

The mandrel body 10*A* is provided with flat side surfaces 16, 17 extending over a major portion of its length and arranged with their planes relatively parallel and symmetrically with repect to, and either side of the axis, the mandrel 10, to facilitate removal therefrom of the workpiece. For ease of manipulation, the mandrel 10 is also provided with a handle or knob 18.

Referring to Figure 3, the workpiece 40 in the form of a pre-rolled substantially tubular semi-finished member, has two substantially semi-circular recesses 43, 44, one at each end thereof, on the side opposite to a pair of opposed seam edges 41, 42 which are to be welded together by a continuous welding seam. The recesses 43, 44 are such as to engage with the pins 13, 14 respectively. The edges 41, 42 together define a longitudinally-extending portion of the workpiece.

In order to perform a welding operation on said longitudinally-extending portion, i.e. along the edges 41, 42 of the workpiece 40, the jaws 20, 21 are first opened by suitably moving the plungers 53 apart, and the mandrel 10 is pulled axially away from between the jaws. The workpiece 40 is then slipped over the mandrel 10, the pin 14 being thereby pushed into the body portion 10*A* of the mandrel against the action of its biassing spring. When the workpiece 40 is in its correct position on the mandrel 10, with the pin 13 engaging in the recess 43, the spring of the pin 14 reasserts itself and permits the pin 14 to resume the position shown in Figure 1, thereby engaging in the recess 44. In this way the workpiece 40 is generally secured in a predetermined angular position about the axis of, and relative to, the mandrel 10, but without the edges 41, 42 being accurately located or held with respect to the mandrel.

As shown in Figures 1 and 2, the mandrel 10 carrying the workpiece 40 is now pushed between the jaws until the mandrel holder 55 engages the stop 65; the plungers 53 are then moved towards each other by application of a suitable force thereto until the spring-mounted pads 27, 26 engage the workpiece, tending to squeeze it slightly so as to begin moving the edges 41, 42 towards each other.

It will be realised that at this stage the workpiece 40 is not truely cylindrical. In the initial position shown in Figure 2, the arrangement is such that the lower portions 61*A* of the jaw faces 61 will tend to engage the workpiece whilst the pads 27, 26 apply opposed radial forces to the workpiece and so act as a radial locating means. Continued movement of the plungers 53 towards each other tilts the jaws in the direction of the arrows in Figure 2, and so eventually brings the whole of the jaw faces 61 into engagement with the workpiece so as to bring and hold the edges 41, 42 together. With the jaws held in this position, the welding head is traversed in the plane I—I (Figure 2) to weld the edges 41, 42 together.

In general, the arrangement and action of the jaws is such that the jaws begin to close when the plungers 53 are moved towards each other, in such a way that first the lower jaw face portions 61*A* of the jaws 20, 21 come into contact with the workpiece 40 and, progressively engaging more and more of the outer surface of the workpiece 40 towards the seam edges 41, 42, the jaws force the edges 41, 42 to approach each other into close relative contact, whilst simultaneously urging the edges 41, 42 into contact with the surface of the mandrel 10, so locating and holding the edges 41, 42 in their predetermined angular position with respect to the mandrel axis and against the mandrel.

Upon completion of the welding operation, the plungers 53 are moved apart to open the jaws 20, 21, and the mandrel 10 is pulled axially away therefrom. The tubular article or workpiece 40 is then removed from the mandrel 10 axially thereof, this removal being facilitated by the said flat surfaces 16, 17.

It will be appreciated that the jig provides correct positioning of the workpiece 40 for welding, in that the edges 41, 42 are positioned exactly below the welding head 57 and also exactly parallel to the axis of

the mandrel 10 and to the welding path of the welding head.

It will also be appreciated that whilst, by reason of its spceial applicability to such an operation, the invention has been particularly described in the context of a welding operation, it is suitable also for use in machining and other manufacturing operations in which the requirements regarding the relative positioning and alignment of a workpiece and a tool are similar or analogous to those herein described.

WHAT WE CLAIM IS:—

1. A jig for holding a substantially cylindrical tubular workpiece for an operation to be performed on a longitudinally-extending portion of the workpiece, the said jig comprising: a mandrel having a body for supporting the workpiece internally of the workpiece and defining a mandrel axis, the mandrel body having locating means for locating said workpiece in predetermined angular relationship on the body about said axis, and the mandrel having retaining means whereby the mandrel may be held at one end thereof; a first jaw and a second jaw, said jaws being mutually opposed and adapted to co-operate with each other to encircle a major portion of the circumference of the workpiece when the latter is on the mandrel, jaw actuating means for moving the jaws towards each other, and means for allowing the jaws to tilt relative to the mandrel about respective jaw axes parallel to the mandrel axis.

2. A jig according to Claim 1, wherein the mandrel is arranged for axial movement with respect to the jaws.

3. A jig according to Claim 1 or Claim 2, wherein the mandrel has a first and a second pin extending substantially radially outwards from the mandrel body, the said pins being spaced apart longitudinally of the mandrel, the one of said pins nearest to a free end of the mandrel being retractable into the mandrel body against biassing means in the mandrel, whereby to permit a said workpiece to be introduced on to the mandrel past the free end thereof and then to locate the workpiece longitudinally between the said pins.

4. A jig according to any one of the preceding claims, wherein the jaw-actuating means comprises a pair of jaw-carrying members movable in opposed relationship in a common plane transverse of the mandrel axis and on opposite sides of the mandrel axis, each jaw-carrying member having a said jaw pivoted with respect thereto to enable the jaw to be tilted in the said transverse plane about a said jaw axis.

5. A jig according to any one of the preceding claims, wherein an inner face of each jaw carries a pad resiliently biassed so as normally to project therefrom towards the mandrel axis but to be retractable into the jaw, the said pads extending generally longitudinally of the respective jaws in opposed relationship to each other, and being so positioned as to engage opposite sides of a said workpiece on the mandrel in spaced angular relationship with the said longitudinally-extending portion of the workpiece.

6. A jig according to any one of the preceding claims, wherein the mandrel includes an electrically conductive bearing plate for internal engagement with the said longitudinally-extending portion of a said workpiece, whereby to serve as a welding electrode.

7. A jig according to any one of the preceding claims, wherein the mandrel is generaly cylindrical but has opposed flattened faces angularly spaced about the mandrel axis from a surface portion of the mandrel for engagement with the said longitudinally-extending portion of a said workpiece, whereby to facilitate removal of the workpiece from the mandrel.

8. A jig for holding a substantially cylindrical tubular workpiece for an operation to be performed on a longitudinally-extending portion of the workpiece, the jig being constructed and arranged substantially as hereinbefore described with reference to Figures 1 and 2 of the accompanying diagrammatic drawings.

9. A welding machine for welding a longitudinal seam of a tubular workpiece and having a jig according to any one of Claims 1 to 8.

10. A method of welding a longitudinal seam on a longitudinally-extending portion of a substantially cylindrical tubular workpiece, the method comprising slipping the said workpiece, having two opposed seam edges in the said portion thereof, on to the mandrel of a jig according to any one of the preceding claims with the workpiece in predetermined angular relationship with the mandrel; engaging the jaws of the jig with the workpiece; moving the jaws towards each other whilst allowing tilting of the jaws to bring the seam edges together and to hold the seam edges against the mandrel; and whilst the seam edges are so held, operating a welding head with relative movement between the said head and edges parallel to the mandrel axis, whereby to weld the edges together.

11. A method of welding a longitudinal seam on a substantially tubular workpiece, the method being substantially as hereinbefore described with reference to Figures 1 to 3 of the accompanying diagrammatic drawings.

12. An article defined by a substantially cylindrical tubular workpiece on which a manufacturing operation has been performed

whilst held on a jig according to any one of Claims 1 to 8.

13. An article defined by a substantially cylindrical tubular workpiece on which a welding seam has been produced in a welding machine according to Claim 9 or by a method according to Claim 10 or Claim 11.

SAUNDERS & DOLLEYMORE,
Chartered Patent Agents,
2a Main Avenue,
Moor Park,
Northwood,
Middlesex, HA6 2HJ.
For the Applicants.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1976
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY
from which copies may be obtained.

1449541 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

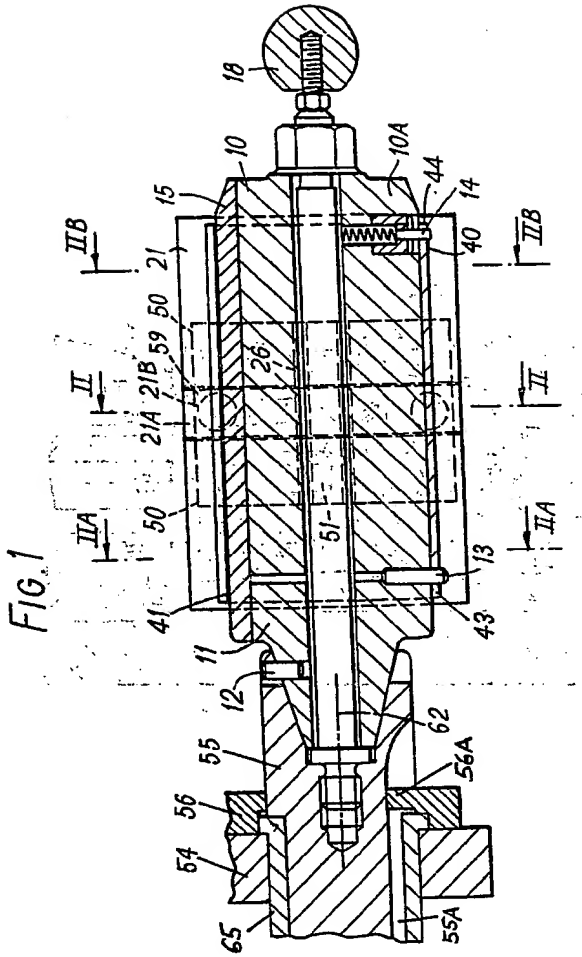
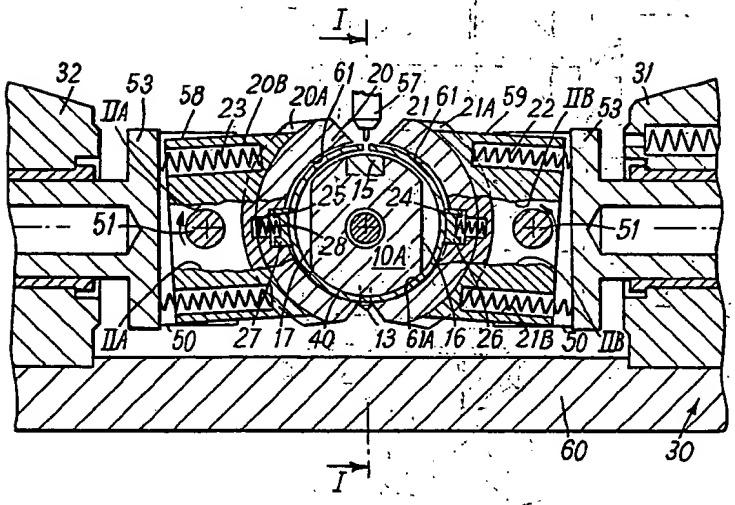


FIG. 1

FIG. 2


I
32
53
IIA
58
23
20B
20A
61
20
57
21
61
21A
59
22
IIB
53
31
51
25
15
24
28
10A
51
IIA
50
27
17
40
13
61A
16
26
21B
50
IIB
60
30
I

1449541 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

FIG.3